Jan. 31, 1967 N. J. KRUG ETAL 3,301,956

SOUND SYSTEM FOR BANKING SERVICE EQUIPMENT

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Fig. 1

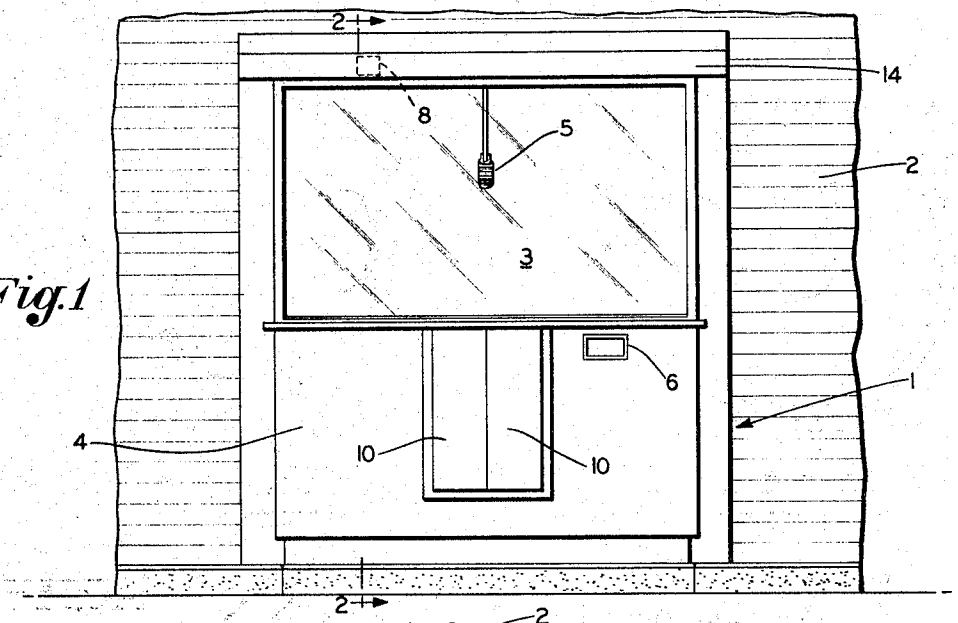
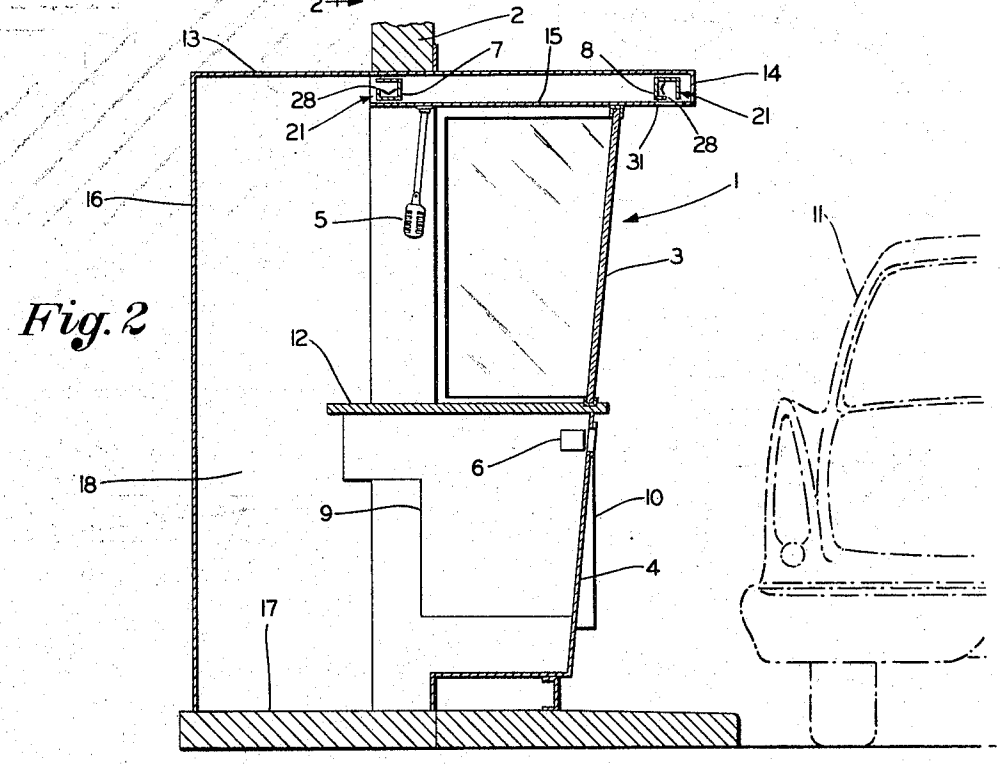


Fig. 2



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Filed June 11, 1963 2 Sheets-Sheet 2

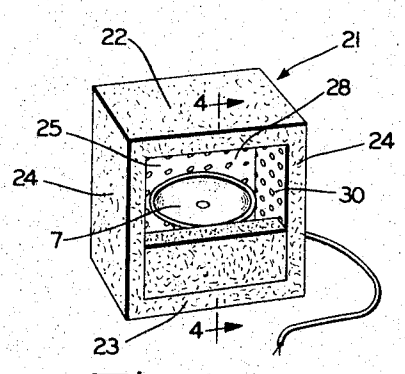


Fig. 3

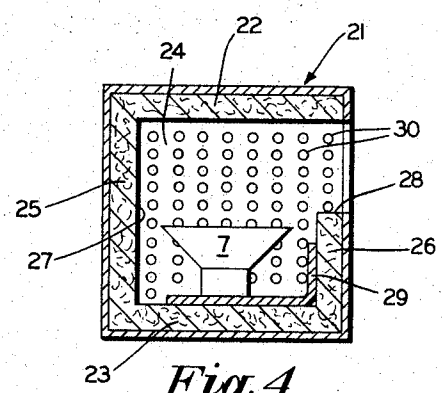


Fig. 4

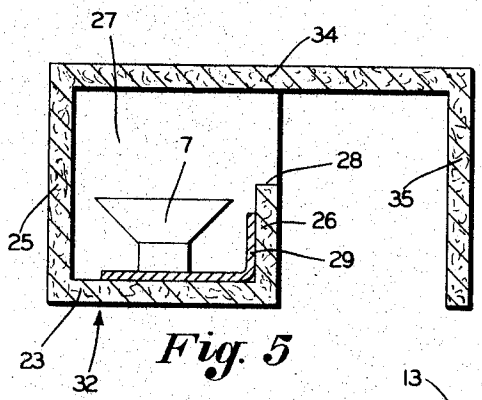


Fig. 5

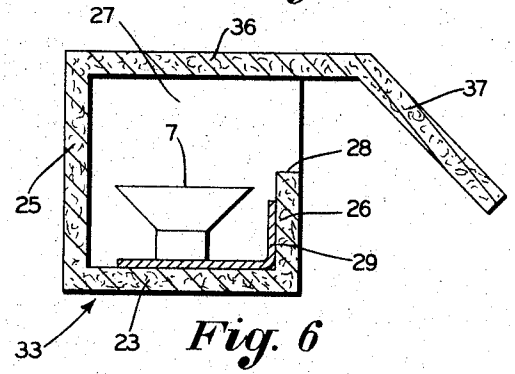


Fig. 6

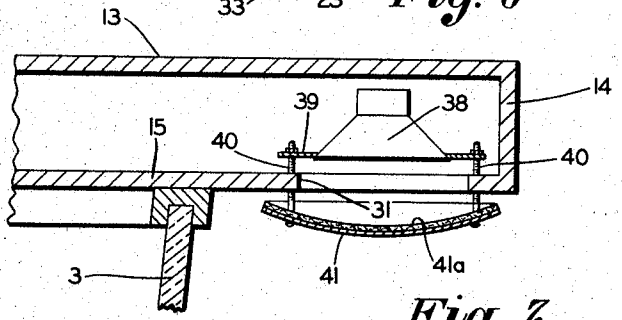


Fig. 7

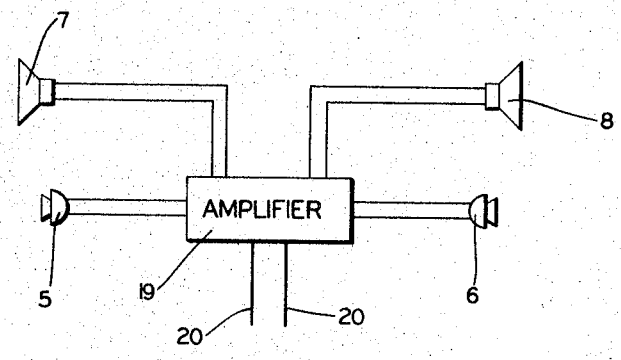


Fig. 8

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SOUND SYSTEM FOR BANKING SERVICE EQUIPMENT

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5 Claims. (Cl. 179—1)

This invention relates to an improved sound reproduction system for banking service equipment used for the convenience of bank customers. More particularly, the invention pertains to a sound reproduction system for eliminating or minimizing feedback.

Among other things banking service equipment permits customer transactions at walk-up windows, drive-up windows, as well as so-called television banking stations. Such equipment usually includes a customer's station and a teller's station separated from each other. Two-way oral communication directly between the customer and the teller is not feasible.

Prior sound reproduction systems for banking service equipment, such as drive-up windows, have been unsatisfactory. Under normal operating conditions, a system may be set for a suitable volume for both incoming and outgoing speakers. Due to distractions of outside noises, such as during traffic hours, it is necessary for a bank teller in a drive-up window to frequently adjust the volume. As a result, feedback usually develops and makes it necessary to immediately turn the volume down below an audible level for which reason most prior audio systems have not been satisfactory.

Feedback is high frequency distortion caused by sounds of a speaker picked up by a microphone. The type of feedback involved here is external of an amplifier. Feedback normally occurs because the microphone is too near the speaker or the sound from the speaker is directed substantially toward the microphone. Feedback is most prevalent where two basic channels or audio systems are operating simultaneously. Where sound systems having dual channel amplifiers with two microphones and two speakers are operating, it is difficult to get good audio quality. Inasmuch as an audio system for a drive-up window merely involves the transfer of voices between two people on the opposite sides of a glass window (sound barrier), a system with the basic components of an amplifier, mikes, and speakers should suffice. Such a basic system is conducive to the problem of feedback, which problem can be readily corrected by the provision of a more complicated amplifier having built-in components for permitting the increase of volume without development of feedback. However, the more complicated sound systems are more costly and their use for mere transfer in a dual channel for drive-up windows is not always justified.

It has been found that the problem of feedback can be satisfied by the use of the basic system with the addition of relatively inexpensive baffle boxes for producing a directional effect upon the sound emanating from the speakers. The baffle boxes are preferably composed of sound-acoustical or sound-absorbent material against which the sound waves from the speaker are initially directed and partially absorbed and from which they are partially reflected. The reflected sound subsequently passes out of the baffle box into the surrounding atmosphere, and has the harsh sound waves eliminated so that feedback is avoided except at very high volumes, i.e., higher than ordinarily required.

Accordingly, it is a general object of this invention to provide a sound system for banking service equipment having acoustical means for partially absorbing as well as partially reflecting initial sound waves from a speaker.

It is another object of this invention to provide a sound system for banking service equipment having a container for a speaker, one side of which container includes a sound escape opening.

It is another object of this invention to provide a sound system for banking service equipment including a two-channel amplifier with two microphones and two speakers, which system avoids the development of feedback within the normal range of sound volume.

It is another object of this invention to provide a sound system for banking service equipment in which a dual channel amplifier provides a microphone and speaker on one side of a sound barrier, and in which another microphone and another speaker are provided on the other side of the sound barrier.

It is another object of this invention to provide a sound system for banking service equipment in which the sound waves from one speaker are initially directed away from a microphone.

It is another object of this invention to provide a sound system for banking service equipment in which the sound waves from the speaker are directional.

Finally, it is an object of this invention to provide a sound system for banking service equipment which is economical to manufacture, easy to operate, and requires a minimum amount of maintenance and labor.

These and other objects and advantages apparent to those skilled in the art from the following description and claims may be obtained, the stated results achieved, and the described difficulties and problems overcome and solved by the parts, elements, constructions, mechanisms, combinations, subcombinations, and arrangements, which comprise the present invention, the nature of which is set forth in the following general statement, preferred embodiments of which—illustrative of the best mode in which applicants have contemplated applying the principles—are set forth in the following description and shown in the drawings, and which are particularly and distinctly pointed out and set forth in the appended claims forming part hereof.

The present invention may be described in general terms as comprising bank service equipment having a customer's station and a teller's station beyond direct oral communication with the customer's station, audio means for providing indirect communication between the stations, said means including a bank teller's microphone and a speaker as well as a customer's microphone and a speaker, each speaker being enclosed in a box-like sound breaker having opposite side, top, bottom, front, and rear side walls, the front wall having a sound outlet opening, and the walls being composed of acoustical material, whereby sound waves from the speaker are partially absorbed at the walls before being reflected from and between the walls before passing through the opening.

Referring to the drawings forming part hereof in which the preferred embodiments are shown by way of example:

FIGURE 1 is an elevational view of a bank drive-up window;

FIG. 2 is a vertical sectional view taken on the line 2—2 of FIG. 1;

FIG. 3 is a perspective view of a feedback breaker;

FIG. 4 is a vertical sectional view, taken on the line 4—4 of FIG. 3, and having a metal casing added;

FIGS. 5 and 6 are vertical sectional views showing different embodiments of the invention;

FIG. 7 is a vertical enlarged sectional view through the top portion of the glass barrier and the support therefor and showing another embodiment of the invention; and

FIG. 8 is a diagrammatic view of a dual-channel audio system of the type involved herein.

Similar numerals refer to similar parts throughout the several views of the drawings.

In FIG. 1 a drive-up window is generally indicated at **1** and is built into a building wall **2**. The drive-up window **1** includes upper and lower portions **3** and **4**, the former of which is composed primarily of glass partitions and the lower portion of which is preferably composed of metal walls. The upper portion **3** is preferably provided with bullet-proof glass to protect persons within the window. An audio system is also provided which includes an inside microphone **5**, an outside microphone **6**, an inside speaker **7**, and an outside speaker **8**. The drive-up window is also provided with a teller's drawer **9** which moves into and out of the window through doors **10** for the convenience of a bank customer seated in an automobile **11**.

Within the drive-up window **1** a work surface or counter **12** is provided above the drawer **9** in a conventional manner. The top of the drive-up window **1** includes a wall **13**, a front wall **14**, and an inturned wall **15**, the latter of which is spaced from the wall **13**, as shown in FIG. 2. A vertical rear wall **16** extends between the top wall **13** and a floor **17**. The walls **13** and **16** together with the upper portion **3** provide a compartment **18** for a bank teller.

Communication between the teller and the occupant of the automobile **11** is provided by a two-way audio system which includes an amplifier **19** (FIG. 8), as well as the inside and outside speakers **7** and **8**. Power supply lines **20** lead to the amplifier **19**.

In FIG. 2 the speakers **7** and **8** are mounted in feedback breakers or box-like enclosures **21**, the details of which are shown in greater detail in FIGS. 3 and 4. The breaker **21** is a rectangular or box-like member having top, bottom, and side walls **22**, **23**, and **24**, respectively. In addition, the breaker **21** includes a rear wall **25** and a front wall **26**. Said walls **22–26** provide a speaker chamber **27** which is completely enclosed except for an opening **28** between an upper edge of the front wall **26** and top wall **22**. The opening **28** constitutes the only communication between the speaker chamber and the exterior of the box **21**. The speaker **7** or **8** is mounted within the chamber **27** on a bracket **29** which is an angle member, the shorter side of which is secured, such as by screws, to one of the walls such as the front wall **26**. The upper edge of the front wall **26** is higher than the upper edge of the speaker **7**. The opening **28** is relatively small compared to the total surface of the breaker **21**. The axis of the speaker **7** or **8** is perpendicular to the top wall **22** and parallel to the front wall **26**. All of the walls **22** to **26** are composed of a sound-absorbent material such as Celotex or acoustical tile having holes **30**. The Celotex walls are about one-half inch thick and preferably composed of corn stalk or sugar cane fiber. The holes **30** cover about 28% of the tile surface.

Sounds emitted from the speaker are directed first against the top wall **22** and rear wall **25** where they are partially absorbed and are partially reflected or bounced and strike one or more of the other walls **23**, **24**, and **26**, until they ultimately pass out of the speaker chamber **27** through the opening **28**. As shown in FIG. 2, the boxes **21** are mounted at the upper side of the drive-up window between the spaced walls **13** and **15**. The opening **28** of the inside speaker **7** faces the rear wall **16** of the drive-up window (FIG. 2). The opening **28** is not directed toward the microphone **5**.

On the other hand, the outside speaker **8** is mounted within the box **21** with the opening **28** directed downwardly and aligned with an opening **31** in the wall **15** so that bank tellers' voices are directed downwardly toward an occupant of the automobile **11**.

Other embodiments of the feedback breaker are shown at **32** and **33**, respectively, in FIGS. 5 and 6. The breaker **32** is similar to the breaker **21** and in addition is provided with an elongated top wall **34** as well as a vertical wall **35** extending at a right angle to the top wall **34** and spaced outwardly from the opening **28**. Likewise, the

breaker **33** is provided with an extended top wall **36** as well as with a wall **37** which is inclined at an angle to the top wall **36**, as shown in FIG. 6, and preferably at an angle of 45° to the plane of the front wall **26** and of the opening **28**. Any sound waves emanating directly through the opening **28** from the speaker **7** which are not first partially absorbed and reflected from one or more of the walls **22–26** of the box **21**, strike the walls **34** and **35**, or walls **36** and **37**, before the sound waves emanate into the room around the breakers.

In FIG. 7 another embodiment of the invention is shown. It includes a speaker **38**, such as an outside speaker, which is mounted within the top portion of the drive-up window within the opening **31**. The speaker is mounted on a mounting plate **39** and above the opening **31** on spaced bolts **40**.

Below the opening a sound reflector **41** is provided and is spaced below the wall **15** on the bolts **40**. The reflector **41** is preferably parabolic or saucer-shaped and lined with a sound-absorbent material **41***a* and is spaced from the speaker **38**. Most of the sound waves emanating from the speaker are partially absorbed and are partially reflected back toward the speaker. As a result, all of the sound waves escaping from the speaker and reflector **41** are reflected at least once from the reflector before escaping around the periphery of the reflector. The reflected waves have less tendency to produce feedback at lower volumes than the unreflected waves. They are similar to the sound waves that pass through the opening **28** of the breakers **21**, **32**, and **33**.

The speakers **7** and **8** have been tested with and without the feedback breakers **21** to determine the maximum volume at which the speaker may be used before feedback occurs. Results of the tests using the human voice and various frequencies are presented in Tables 1–6 for the voice and in Tables 7–9 for frequencies. Test No. 1 was conducted with both channels (incoming and outgoing) at the same volume level with the voice of the teller being checked. A decibel meter was placed approximately three feet above the floor level and directly below and aligned with the outside speaker **8**.

Table 1.—Maximum volume readings at the lower edge of feedback

	Decibels
Without breaker	86
With breaker	90

An increase of 4 decibels is available before feedback occurs with the use of the feedback breakers.

Test No. 2 was a repetition of the first test except that the incoming channel was turned down to volume level where the amplifier was acting substantially as a one-channel unit.

Table 2.—Maximum volume readings at the lower edge of feedback

	Decibels
Without breaker	88
With breaker	92

An increase of 2 decibels under each condition (with and without breakers) is available over the results of Test No. 1.

Test No. 3 was made with both channels at the same volume level with the voice of the customer being tested. The decibel meter was placed upon the counter top **12**.

Table 3.—Maximum volume readings at the lower edge of feedback

	Decibels
Without breaker	92
With breaker	98

An increase of 6 decibels before feedback is available with the use of the feedback breakers.

Test No. 4 was a repetition of the conditions of Test No. 3 except that the outgoing channel was reduced to a

volume level where the amplifier was acting substantially as a one-channel unit.

Table 4.—Maximum volume readings at the lower edge of feedback

	Decibels
Without breaker	92
With breaker	98

An increase of 6 decibels is available before the feedback occurs with the use of the breakers.

Test No. 5 was made with the volume of both channels wide open. A decibel meter was located about three feet above the floor and directly below the outside speaker to test the teller's voice on the outgoing channel.

Table 5.—Maximum volume readings at the lower edge of feedback

	Decibels
Without breaker	94
With breaker	100

An increase of 6 decibels is available where the feedback breakers are used.

Test No. 6 was made with the volume of both channels wide open. A decibel meter was placed upon the counter top **12** in order to test the customer's voice on the incoming channel.

Table 6.—Maximum volume readings at the lower edge of feedback

	Decibels
Without breaker	94
With breaker	100

Again an increase of 6 decibels is available with the use of feedback breakers.

Another series of tests were made to test the effect of various frequencies on both channels with and without the feedback breakers. For that purpose various audible frequencies were first recorded upon a sound-recording tape and then played into the incoming channel and then the outgoing channel.

Test No. 7 was made with both channels at the same volume level. The decibel meter was located at an elevation of three feet above the floor and directly below the outside speaker 8. The tape in a tape recorder was played on the counter on the teller's side of the window **3**. Results are listed in Table 7.

Table 7.—Maximum volume readings at the lower edge of feedback

Frequency in c.p.s.	Decibels Without Breakers	Decibels With Breakers
200	78	79
400	85	91
600	82	88
900	83	86
1,100	84	78
2,000	73	80
4,000	72	74

Test No. 8 was made with both channels at the same volume level. The decibel meter was located on the teller's counter top and the tape recorder as the source of frequency was located on the outside of the drive-up window at a location substantially the same as the customer in the automobile **11**.

Table 8.—Maximum volume readings at the lower edge of feedback

Frequency in c.p.s.	Decibels Without Breakers	Decibels With Breakers
200	72	76
400	73	76
600	72	78
900	74	77
1,100	73	79
2,000	72	74
4,000	73	78

In addition to the foregoing tests made for the human voice and for varying constant frequencies, various types of material were tested for feedback breakers and for decibel readings for various frequencies and for voice as follows:

Type 1—Celotex liner in a metal box.

Type 2—Celotex box without metal liner and larger than Type 1.

Type 3—Fiber glass liner in metal box.

Type 4—Celotex box without liner.

Decibel readings for various frequencies and the human voice in breakers composed of different types of material are listed in Table 9.

Table 9.—Maximum volume readings at the lower edge of feedback

Frequency in c.p.s.	Decibels Types 1 and 4	Decibels Type 2	Decibels Type 3
200	76	72	74
400	78	74	76
600	79	76	77
900	78	76	76
1,100	78	74	76
2,000	76	74	73
4,000	76	74	74
Voice	88	80	80

The results of the foregoing tests clearly indicate that the sound system for a drive-up window may be operated at increased volumes before developing feedback. A more satisfactory sound system is provided by mounting the inside and outside speakers **7** and **8** in feedback breakers.

The sound system with feedback breakers may be operated continuously at a higher level without developing feedback. Thus, the teller need not constantly increase the volume due to outside excessive noises and subsequently reduces the volume to eliminate feedback.

The device of the present invention provides a satisfactory feedback breaker in which speakers for a sound system are placed for producing a directional effect upon sound waves emanating from the speakers. The use of sound-absorbent or acoustical material such as Celotex effectively eliminates the harsh sound waves or sound components which normally cause feedback at lower volumes. A completely satisfactory sound system is provided which can be operated at higher volume levels without causing the discomforts of feedback.

In the foregoing description certain terms have been used for brevity, clearness and understanding, but no unnecessary limitations have been implied therefrom as such words are used for descriptive purposes and are intended to be broadly construed.

Moreover, the embodiments of the improved construction illustrated and described herein are by way of example and the scope of the present invention is not limited to the exact construction shown.

Having now described the invention, construction, operation and use of preferred embodiments thereof and the advantageous, new and useful results obtained thereby; the new and useful sound system for banking service

equipment and reasonable mechanical equivalents thereof obvious to those skilled in the art are set forth in the appended claims.

What is claimed is:

1. In banking service equipment having a customer's station and having walls forming a teller's station beyond direct oral communication with the customer's station, audio means for providing indirect communication between the stations and including a teller's microphone and a speaker at the teller's station and a customer's microphone and speaker at the customer's station; the combination therewith of a box-like enclosure for each speaker, the enclosure having opposite side, top, bottom, front, and rear walls, the front wall having a sound outlet opening, the inner surfaces of the walls being composed of a sound-absorbent material, whereby sound waves emanating from the speaker are partially absorbed at and are partially reflected from the various walls of the enclosure before passing through the opening.

2. The construction of claim 1 in which the axis of the speaker is parallel to the plane of the opening in the front wall.

3. The construction of claim 1 in which the inner surfaces of the walls are composed of Celotex having a plurality of spaced apertures therein.

4. The construction of claim 1 in which the speaker faces the top wall of the enclosure, in which the front wall extends from the bottom wall toward the top wall and has an upper edge spaced from the top wall to form the opening, and in which the upper edge of the front wall is closer to the top wall than the speaker.

5. The construction of claim 1 in which the sound outlet opening is relatively small compared to the total area of the enclosure.

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